

MANURE

Rates per acre of artificial manures:

Ammonium Sulphate	1 cwt.
Superphosphate	2 cwt.
Plutophos	1 cwt.
Potassium Chloride	$\frac{1}{2}$ cwt.
Calcium Cyanamide	$1\frac{1}{2}$ cwt.
Basic Slag	2 cwt.

Complete mixture is Amm. Sulph + Superphosphate
+ Pot. Chloride, but the last can be omitted.
Plutophos can be used in place of Superphosphate
if half the quantity is used.

Opium Refuse as Manure.

Owing to the very rapid increase in the price of cowdung as well as the great difficulties in obtaining it, various substitutes ^{have been} ~~were~~ ^{tried} in under ~~xxxxxxxxxxxx~~ this garden since the year 1920, Opium Refuse (~~Chen~~ ^{do}) being one of them. By burying deeply in the soil ~~xx~~ or by mixing it with cowdung so as to inoculate it with bacteria, its decomposition it was thought, would be sufficiently rapid (Rept. Bot. Gardens, 1920, p. 2). Although ~~this~~ substance was under observation since that year, definite experiments could be undertaken only in the second half of ~~the~~ the year 1923, and then too, owing to the closing of the Economic Gardens, only a preliminary trials could be made. The following is ^a report on these trials.

Plot Experiments

Two contiguous plots of fairly uniform character were chosen. On one some rubbish was burnt and the ash removed some two months previous to its preparation for the present experiments, while the other was not treated at all. Both were fallow for more than six months and no manure was used on them for more than a year. After having been cleared of all weeds, each of these plots was properly tilled and divided into four beds, each measuring 19x3 feet at the top of the bed (for the bed had sloping slopes), and 3/4 ft. deep ^{each measuring} ~~3/4 ft.~~ ^{at the bottom} ~~were made to run all round the beds and were provided with outlets at frequent intervals~~ ^{between, a parallel to the lengthwise of b} ~~so that the drainage water from the beds may be quickly removed off.~~ In each plot a bed was kept unmanured as control, while the other three beds were manured with ^{cowdung,} ~~old opium refuse,~~ ^{and mixed with black surface soil} ~~fresh refuse, and cowdung~~ respectively, at the rate of one and half rubbish basket per bed. The old opium refuse had been buried deep for some two years mixed with leaf-mould in ~~alterna~~ ^{ternate} layers; when it was dug out no trace of leaves could be detected with a naked eye and refuse had formed into a hard cake. It had, therefore, to be pounded to bits before it could be used as a manure. The fresh opium refuse was

* The information regarding the previous treatment of the plots and the ^{old} refuse was supplied by the ^{late} foreman-gardener of the Economic Garden.

Botanic Gardens, Singapore,

at 100

from Singapore Botanic Gardens

~~1000~~ 1000

1000

1000

mixed with equal quantities of black surface soil rich in organic matter and was kept buried for two days before it was used. The cowdung used was partly dry and had very little of grass mixed with it. ~~xxxxxx~~
~~xxxxxxxxxxxxxxxx~~ These substances were spread on their respective beds and lightly forked in so as to mix it with the soil. Each bed was then planted with twenty ten-days-old amaranthus seedlings (the Indian spinach). Excepting the rainy days, the beds were watered regularly every evening, kept clean of weeds and once forked eighteen days after transplanting. Throughout the experiment one could note from the sickly growth that the plants were worse off due to the opium refuse manure than the ones with no manure, the injurious effect of the fresh chando being more marked than ^{that of} the old one. Some plants on the beds with opium refuse died and were replaced with fresh ones of nearly equal size. A leaf roller pest occurred but the insects were handpicked from ^{to time} as they appeared. The plants manured with chando were the ones most subject to the attacks ~~by~~ the insects, while the plants manured with cowdung manure were almost free.

Six weeks after transplanting the plants were carefully uprooted ~~xxx~~ so as to injure the roots as little as possible, washed off to remove all the earth at the roots, and were weighed. It was found that the opium refuse, both old and fresh, had distinctly decreased the yield as could be seen by comparing the yield of the control plot (vide Table I). An examination of the roots growth showed that the plants with opium refuse had made very little of surface root growth and that there were only a few roots which went straight downwards. The root ~~xxxxxx~~ growth of plants manured with old opium refuse was little better than that of the plants with fresh refuse, but was very much poorer than the root growth of the plants grown on check plots ^{on} or beds manured with cowdung. Their roots too had very little of surface root growth and root hairs, nearly all the roots showed a downward tendency. There was very little difference between the root growths of plants grown on check plots and those plots manured with cowdung, ~~but the~~ ^{except} that the former had longer surface root growth, while the latter had more ^{lower down} roots growing in the soil.

B 2.11/4

After the ^{har} ~~ag~~ vest of the crop, the ~~pinxxxxxx~~ beds were fallowed for a period of twelve days.

for period of twelve days during which they were forked five times and received copious watering ~~xxxx~~ by frequent showers of rain. The beds were then replanted with ten-days old amaranthus seedlings. During the early life of the plants one could again note the harmful effect of the opium refuse on the plants. Further observations on these plants had to be discontinued as too many insect parasites began to encroach on these beds from weeds in the surrounding areas the cultivation of which ~~xxx~~ had been abandoned.

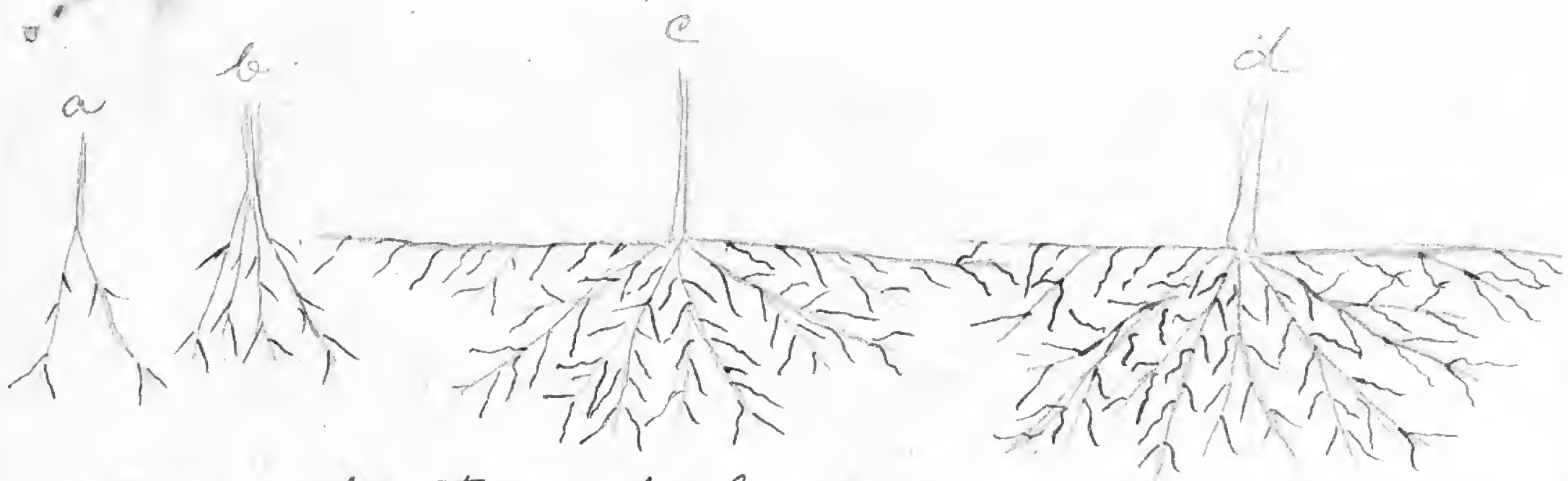
Pot. Experiments

Another set of experiments were made in pots to test the manurial value of opium refuse when mixed with well-rotten leaf-mould. For this purpose surface soil was taken from a completely fallow locality and was mixed one-third with river sand so as to improve its physical condition. This set constituted of pots with chando, leaf-mould, and chando mixed with equal quantity of leaf-mould. The quantity of manure used was one-third of the soil by volume, and the plants selected for these experiments were *cosmos*. Here too it was observed that the old opium refuse had exerted a very injurious influence both on the plant growth and flower production, and this was so even when the opium refuse was mixed with leaf-mould (vide table II).

Side by side with ~~main~~ these, pot tests were made ~~XXXXXXXXXXXX~~
the extract from opium residue taken by macerating it for 24 hours in
double the quantity of water, was more harmful

side by side with these *tests*, another ~~tests~~ *trials* were made in which the opium refuse was macerated in double the quantity of water for 24 hours, and the ~~xxx~~liquid extract obtained by straining through a gunny bag and the residue were used in separate pots. In these tests *in which only four plants were* it was found that both the residue and the liquid ~~xxx~~ extract were harmful to the life ^{of} plants, though it appeared that solid residue was more harmful than its liquid extract, probably because of the *fact that* ~~xxxxxxxxxxxxxxxx~~ the latter was ~~xxxxxxxx~~ more easily susceptible to be ~~drained~~ *more easily washed away by drainage* ~~xxxxxxxx~~ *away by the rain water. Only four plants were used in these* ~~tests.~~ *water and that there were frequent* *howers of rains during the growth of the plants.*

From the foregoing results it appears that the opium refuse is not decomposed as easily as it was thought first and that it is no good as a manure unless it is subjected to some treatment other than merely burying it ~~neither~~ alone or mixed with soil, leaf-mould, etc.



- (a) = root system of plants growing on fresh chand
 (b) " " " " old chand
 (c) " " " " no manure
 (d) " " " " cowdung.

Table I

XXXXX		Old opium refuse	fresh opium refuse	
Beds	Old Opium refuse	fresh opium refuse	Cow-manure	Control
XXXXXXXXXX				
Burnt Plot	13 lbs.	5 $\frac{1}{2}$ lbs. _a	33 $\frac{1}{2}$ lbs.	20 lbs.
Unburnt plot	8 $\frac{1}{2}$ lbs. _b	4 $\frac{1}{4}$ lbs. _c	22 lbs.	12 lbs.
Total	21 $\frac{1}{2}$ lbs.	9 $\frac{3}{4}$ lbs.	55 $\frac{1}{2}$ lbs.	32 lbs.

a Five plants ~~had~~ died in this plot and ~~new ones~~ substituted.

b only one had died and was substituted.

c- ditto.

Table II

Plants	Height measurements								Total weight	Average weight
	1	2	3	4	5	6	7	8		
A 8/11 Cnando and leaf-mould	27	20	37	13 _a	30	23	34	17	6 $\frac{3}{4}$.844
B Cnando	29	20	34	35	23	20	25	30	6 $\frac{1}{2}$.766
C Leaf-mould	35	50	50	41	36	33			15	2.5

~~The~~

The height measurements ~~xxxxxxxx~~ are in inches and the weight in ounces.
Plants in series

~~xxxxxxxxxxxxxxxxxxxxxxxx~~ Plants A and B had very few branches and few flowers, and most of the plants looked very sickly. All plants in series C were vigorous and many branches and flowers.

a This plant was dying.

Department is not altered by the current proposal that the Director of Gardens should have his centre of work in Kuala Lumpur because the proposal does not extend to moving the Assistant Director, who, resident in Singapore, will in my plans carry on his study of the Cryptogams in the laboratory that we have prepared for him, and no one in the country will be better than he in knowledge of foreign fungus pests while ~~which~~ as a horticultural officer~~s~~ he is compelled to know insect pests and as an observer of disease in plants to be experienced ~~in~~ ⁱⁿ diagnosing injury to vegetation of all kinds. From the Gardens, when notified by your preventive service of the arrival of plants to be inspected, he will proceed to the docks or other place to examine the consignment and will admit, refuse admittance or quarantine ~~it~~ ^{them} as necessary.

5. He will establish a small quarantine observation plant house in Singapore.

6. Entry or exit of plants into or from Penang would have to be controlled by the Assistant Curator; and that officer in difficulties would refer to higher officers in this Department. He also will need a small quarantine plant house.

7. I do not believe that your post officers are ready at the moment to exercise any discretion in stopping forbidden ~~vegetation~~ vegetation from entry. They must be taught these duties or our orders are useless. They must be taught to report by telephone to the proper authority when any material arrives which seems possibly prohibited.

I have the honour to be,
Sir,
Your obedient Servant,

Sgt. L. W. Burkill

Director of Gardens

The Honourable the
Colonial Secretary
Singapore

